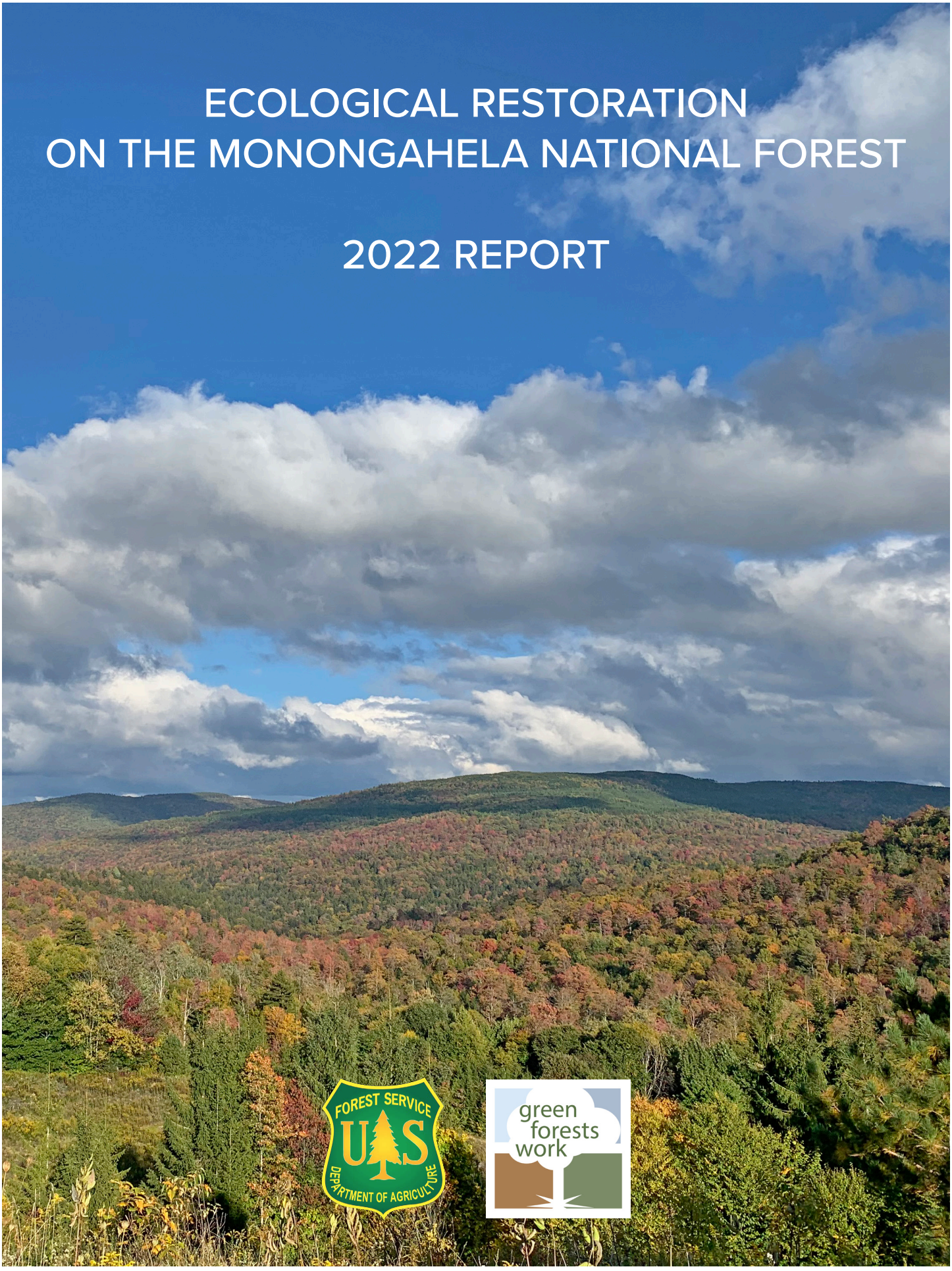
ECOLOGICAL RESTORATION ON THE MONONGAHELA NATIONAL FOREST

2022 REPORT



GREEN FORESTS WORK'S MISSION

Green Forests Work's (GFW) mission is to re-establish healthy and productive forests on formerly mined lands in Appalachia.

VISION

GFW's vision is to create a renewable and sustainable multi-use resource that will provide economic opportunities while enhancing the local and global environment by converting reclaimed, non-native grasslands and scrub lands into healthy, productive forestland.

Our reforestation projects provide jobs for equipment operators, nursery workers, and tree planters, and improve the environment by eradicating exotic species and restoring ecosystem services. With the help of our partners and volunteers, this vision is quickly becoming a reality...

Since 2009, we have planted more than five million trees on more than 9,400 acres.

BACKGROUND

Green Forests Work (GFW) is a 501(c)(3) nonprofit organization housed at the University of Kentucky. GFW's mission is to restore healthy, productive, native forests on lands that have been impacted by coal surface mining in the Appalachian region and beyond. For over a decade, GFW has been working with the US Forest Service to restore red-spruce ecosystems on the Monongahela National Forest. This work has been performed at the Mower tract in the Greenbrier Ranger District and at Sharp Knob. The following provides an overview of restoration activities that have occurred between 2011 and 2022.

RESTORATION BENEFITS

RED SPRUCE

Red spruce for this project are grown from locally collected seed.
Photo courtesy of Dave Saville

Red spruce (*Picea rubens*) influenced forests have severely declined in West Virginia: The Red Spruce – Yellow Birch Forest (G2S2) and the Red Spruce – Southern Mountain Cranberry Forest (G2S1), which surrounds the Mower Tract, are imperiled[1] and critically impaired[2] communities within the state, respectively. Protecting and re-establishing these communities is of conservation concern because they support 240 rare species in West Virginia alone (see page 4). Red spruce have a limited range due to their specific site requirements. They grow best in cool, moist climates, which is why the high elevations of the Appalachian Mountains are one of the few places that can support their growth. Cheat Mountain, where the Mower Tract is located, has been identified by the Central Appalachian Spruce Restoration Initiative and The Nature Conservancy as a key red spruce corridor and top priority for conservation. Corridors connect large communities together, acting as roadways for all the living things within them. Having these connections between large communities allows species to move further north as the southern extent of their range becomes inhospitable due to climate change.

Tree planters prepare for a day of planting at the Mower Tract.

[1] Imperiled (S2) is a conservation status designated by NatureServe meaning that the species has a high risk of extinction due to restricted range, relatively few populations (80 or fewer), recent or widespread declines, or other factors.
[2] Critically imperiled (S1) is a conservation status designated by NatureServe meaning that the species has a very high risk of extinction due to extreme rarity (five or fewer populations), very steep declines, or other factors.

WILDLIFE

Numerous species are dependent on the red spruce ecosystem, several of which are of conservation concern due to the decline of red spruce communities. In West Virginia, 240 rare species are associated with red spruce ecosystems. Most notably and specific to the project site is the Cheat Mountain salamander (*Plethodon nettingi*; G2S2; LT), which is imperiled within the state and is a federally listed endangered species. As its name implies, this salamander's range covers a very small area only in the high elevations of the Allegheny Mountains in West Virginia, where its preferred spruce forest types occur. Similarly, the West Virginia northern flying squirrel (*Glaucomys sabrinus fuscus*; G5T2S2) is also imperiled within the state and only occupies select areas in West Virginia and Virginia because its forage and habitat are strongly associated with the declining spruce-influenced forests. In addition to the decline of red spruce ecosystems, the southern water shrew (*Sorex palustris punctulatus*; G5T3S1) is critically imperiled within the state, likely because of habitat acidification and the warming and siltation of headwater streams due to coal mining.

The restoration work at the Mower Tract will also benefit numerous birds, as more than 80 species of Neotropical migratory songbirds are known to breed in the Tract, and more than 100 others use it as a stopover point during spring and fall migrations. Restoration efforts on the Mower Tract will immediately benefit a variety of species, most notably those that use early successional, wetland, and restored mine site habitats. In the long-term, restoration efforts will benefit more than 24 Neotropical migratory songbird species dependent on the red spruce ecosystem, including state-imperiled breeding populations of the Pine Siskin (*Carduelis pinus*; G5S2B) and the Northern Waterthrush (*Seiurus noveboracensis*; G5S2B). The state-imperiled Northern Saw-whet Owl (*Aegolius acadicus*; G5S2B) and seven other state-vulnerable (S3) breeding populations of birds associated with this ecosystem also stand to benefit from restoration. As the forest matures, more secure species such as Appalachian cottontail, snowshoe hare, whitetail deer, black bear, wild turkey, ruffed grouse, and many others will also benefit from restoration efforts.

Numerous wildlife species have been documented utilizing the restoration areas.

Camping sites established at the Mower Basin get frequent use due to stunning views and proximity to newly created hiking and biking trails.

COMMUNITY SERVICES

In addition to providing a multitude of environmental benefits, forest restoration provides immediate and future economic benefits. Contract services and supplies for soil decompaction, tree planting, wetland creation, and cultivation of seedlings have put millions of dollars back into a region that has experienced a severe economic downturn due to the decline in the coal industry. Re-establishing red spruce will also help generate future revenue for the Forest through sustainable timber harvesting. Red spruce is a high-value species because of its use in paper manufacturing and construction. It has added economic and cultural value in the region because it is a preferred material for many stringed instruments that are popular in bluegrass music.

One of the things we learned from the COVID-19 pandemic was that more opportunities for outdoor nature-based experiences are needed. During the pandemic, parks and public land saw a substantial increase in visitors. The need for fresh air, exercise, companionship, and an escape from remote working led to this increased usage. As we consider new opportunities for expanding recreation infrastructure on public land, areas that are underutilized, such as abandoned and legacy mines, should be improved for these uses.

At the Mower Tract, development of recreation infrastructure went hand in hand with the ecological restoration work. Dozer trails developed to traverse the restoration areas were improved and converted to hiking and biking trails (Figure 1). Cleared areas were leveled to provide campsites. The clearing of the non-native trees opens the view shed of the restoration areas to visitors, and in the near future, a more visually interesting landscape will be established. Habitat improvement will promote hunting and wildlife viewing opportunities. To date, 8 miles of hiking/biking trails have been developed (6 more proposed) and over 30 campsites have been created in the restoration area.

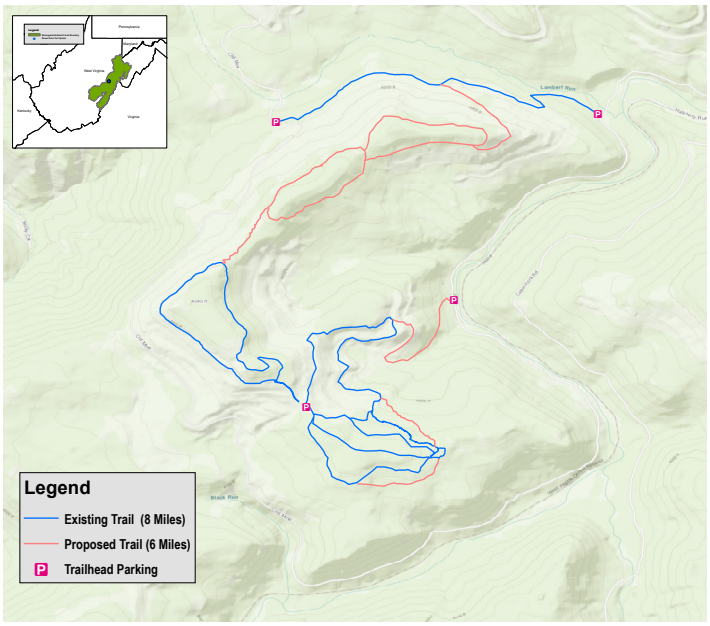


Figure 1. Map of created trails within restoration area at the Mower Tract.

A large bulldozer equipped with ripping shanks removes unwanted vegetation and decompacts soil at site.

RESTORATION TECHNIQUES

NON-NATIVE SPECIES REMOVAL

Grasslands and plantations of non-native trees, such as Norway spruce and red pine, were created on the mined areas during the reclamation process. The non-native species that were seeded and planted did not provide the same ecosystem services as native red spruce and needed to be cleared before soil decompaction activities could be performed. Although the non-native pines and Norway spruce could tolerate the compacted soil better than many native tree species, they still did not develop healthy roots or grow vigorously.

Since the stunted, non-native trees had little value for lumber or furniture, they were knocked down by a bulldozer or excavator, pushed into piles, and then scattered across the site after ripping. As they decompose, they will provide valuable functions on the site. The dead wood provides a suitable growth medium for mosses, lichens, and fungi, which support a variety of wildlife. The woody debris also provides habitat for a variety of insects, birds, and mammals. As the wood decays, nutrients and organic matter are provided to the soil, increasing the soil's fertility and water-holding capacity. The downed trees also increase the rate of natural regeneration by acting as perches for songbirds such as Dark-eyed Juncos (*Junco hyemalis*), which spread native seed in their droppings. Fire cherry (*Prunus pensylvanica*) is not planted but can be seen growing prolifically amid the piles of downed trees. Colonization of fire cherry and other native species has been attributed to the "perch effect," which increases species richness and the abundance of locally adapted plants.

SOIL DECOMPACTION

Mitigating soil compaction is the most critical step in putting mined lands on a trajectory toward becoming native forests. Loosening the soil allows native plants to naturally regenerate by providing a suitable medium for root growth, while planting trees facilitates the process. Ripping is typically done

in the fall when the soil is dry to maximize soil fracturing. Komatsu America Corp. has been providing equipment and funding to assist with site preparation since 2019. After the non-native trees are cleared by a Komatsu D61 bulldozer and PC210 excavator, local contractors rip the land using a Komatsu D155 bulldozer equipped with dual, rear-mounted ripping shanks (Photo page 6). The shanks are spaced eight feet apart.

WETLAND CREATION

After the ripping and scattering of downed trees, a contractor is hired to create wetlands and vernal pools of varying depths and sizes. More than 1,700 wetlands have been created by an excavator based on observed drainage patterns, evaluation of soils and sub-surface conditions, and previous work. Some of the drainages and sediment ponds that were created by the mining company have also been improved and planted with wetland plants. The wetlands are created to intercept and retain precipitation and groundwater and trap sediment. They also provide habitat for amphibians and other wildlife species, and they provide suitable conditions for 145 state rare plant species known to be associated with wetlands in the High Alleghenies, including 60 critically imperiled (S1) species, 56 imperiled (S2) species, and 29 vulnerable (S3) species.

PLANTING OF NATIVE SPECIES

In the spring following ripping, the reforestation sites and wetlands are planted with a variety of native plants by volunteers and professionals. Depending on the species, plants are established through direct seeding, or by the planting of bareroot seedlings, containerized/potted plants, and seedling plugs. To increase survival, the seeds and plants are purchased or grown from a locally adapted seed source. Each planting year from 2010 to 2019, the Natural Resources Conservation Service- Appalachian Plant Materials Center provided seed and plants grown from seed collected in high elevation areas across the Monongahela National Forest.

Red spruce is the largest component of every planting, overall comprising 41% of the total seedlings planted. Other native species are selected based on their benefit to wildlife, their association with red spruce forests and wetlands in the High Alleghenies, and how they compete with red spruce. For example, aspen is the second largest component of the plantings overall, because it is a fast-growing species and provides food and cover for wildlife, helping to quickly establish an early successional habitat. Aspen are also short-lived compared to red spruce and northern hardwoods, so they will not compete with these trees and will eventually be overshadowed by them. The average planting density is 536 plants/acre, which leaves sufficient open spaces for natural regeneration.

Hundreds of pounds of native seed, especially flowering species for pollinators, have been handspread on freshly ripped ground to increase herbaceous plant biodiversity. To the left, Appalachian Conservation Corps members mix seed before spreading on Mower 22.

MOWER TRACT: SITE HISTORY AND PROJECT GOALS

The Mower Tract (40,000 acres) of the Monongahela National Forest was purchased from the Mower Land and Lumber Company in the early 1980s. It is located on Cheat Mountain (4,848 ft elevation) in Randolph and Pocahontas Counties, West Virginia (Figure 2). The Mower Tract and the surrounding high elevation areas were historically dominated by old-growth red spruce and red spruce-northern hardwood forests; but after the industrial logging era of the late 19th and early 20th centuries, the red spruce ecosystem in the West Virginia highlands was reduced by an estimated 90%. Clear-cut slash ignited unnaturally hot wildfires, which eliminated the red spruce seed source and caused former red spruce forests to be replaced by even-aged, hardwood dominated forests. Extensive logging was linked to regional flooding and was key to the establishment of the Monongahela National Forest.

In addition to logging, coal mining further reduced and prevented the re-establishment of red spruce communities in West Virginia. In the Mower Tract, approximately 2,000 acres were surface mined for coal. Reclamation laws required mining companies to return the site to approximate original contour and to control erosion, which was accomplished by compacting soils and planting non-native trees or seeding aggressive grasses and legumes. The Mower Tract was reclaimed to non-native conifer plantations and pasture and remained this way for over 30 years. Native species could not recolonize the reclaimed sites because of the compacted soils and thick grass cover.

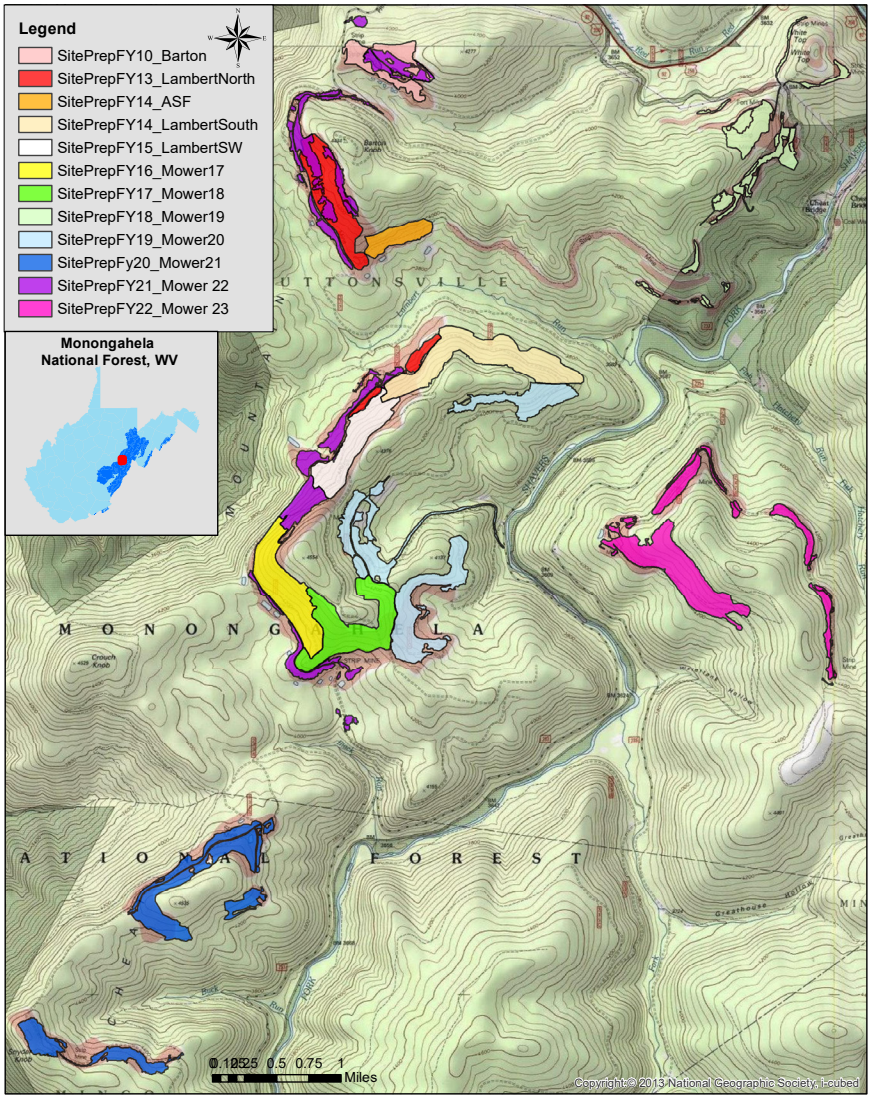


Figure 2: Map of restoration areas by year at the Mower Tract.

Starting in 2010, the U.S. Forest Service began a partnership with Green Forests Work (GFW) and the Appalachian Regional Reforestation Initiative (ARRI) to conduct a suite of restoration activities, including non-native species removal, organic matter loading, soil decompaction, mined land reforestation, and wetland creation. In the short term, the goal is to create an early successional habitat, with the ultimate goal being to establish a forest that is at least 30% red spruce. Ancillary benefits include improved water quality, enhanced wildlife habitat, and improved ecosystem services, such as carbon sequestration.

One of the 108 wetlands created in 2021 and planted in 2022. Repurposed woody debris provides habitat structure for aquatic, as well as terrestrial wildlife.

2022 MOWER RESTORATION

In 2022, GFW and partners planted 117,252 trees and shrubs and created 180 wetlands. Prior to planting, non-native species were removed and the soil was decompacted. In total, 1,284 acres have been restored in the Mower Tract. This has included the creation of more than 1,646 wetlands and the planting of nearly 684,000 trees and shrubs (Table 1). Although the majority of the planting has been accomplished by professionals, more than 500 volunteers have assisted us in these efforts, as well as Appalachian Conservation Corps, AmeriCorps members annually since 2020. Table 2 lists the 60 native tree and shrub species and 4 herbaceous species that have been planted on the Mower Tract restoration areas over the years.

Table 1. Yearly summary of restoration activities.
[1] In addition to the 192 ripped acres, 8 acres of non ripped slopes were planted.
[2] In addition to the 171 ripped acres, 18 acres of land ripped in the past project years were planted.
[3] There is an overlap in the species planted each year. Across all years, more than 60 species of trees and shrubs have been planted, as well as many more species of herbaceous transplants and seeds.

Year Planted	Restoration Area (ac)	Wetlands Created	# Trees and Shrubs Planted	# Species Planted	Volunteers Engaged
2011	90	135	22,550	12	60
2013-2014	105	75	28,485	8	117
2015	116	279	46,937	11	49
2016	65	100	35,436	22	90
2017	95	318	76,782	32	90
2018	200	175	93,308	35	14
2019	58	192	51,108	23	85
2020	200[1]	84	92,318	21	0
2021	184	108	119,718	32	20
2022	189[2]	180	117,252	31	0
TOTAL	**1,284**	**1,646**	**683,894**	**60 total[3]**	**525**

Table 2. Summary of the 60 native tree and shrub species and 4 herbaceous species that have been planted on the Mower Tract restoration areas over the years, along with their percentages of the total.

Species	Total Planted	% of Total	Species	Total Planted	% of Total
Red Spruce	304,952	44.59%	Maple Leaf Viburnum	1,500	0.22%
Bigtooth/Quaking Aspen	69,529	10.17%	Beech	1,415	0.21%
Speckled Alder	46,398	6.78%	Yellow Birch	1,413	0.21%
Black Cherry	36,501	5.34%	Bush Honeysuckle (Native)	1,384	0.20%
Silky Dogwood	19,643	2.87%	Red Oak	700	0.10%
Mountain Ash	18,807	2.75%	Blackhaw	652	0.10%
Winterberry Holly	17,637	2.58%	Other	432	0.06%
Red Osier Dogwood	16,850	2.46%	Fraser Magnolia	339	0.05%
Arrowood Viburnum	15,607	2.28%	Catberry	312	0.05%
Black Chokeberry	12,908	1.89%	Pin Cherry	250	0.04%
Serviceberry	12,178	1.78%	Bear Oak	240	0.04%
Sugar Maple	11,471	1.68%	Silky Willow	200	0.03%
Red Maple	11,292	1.65%	Red Raspberry	101	0.01%
Chokecherry	10,756	1.57%	Late Figwort	100	0.01%
Balsam Fir	8,780	1.28%	Red Chokeberry	100	0.01%
Hazelnut	8,515	1.25%	Steeplebush, Pipestem	100	0.01%
Black Elderberry	5,565	0.81%	Highbush Cranberry	75	0.01%
Witch hazel	5,150	0.75%	Red Mulberry	75	0.01%
Wild Raisin	4,953	0.72%	Swamp Rose	34	0.00%
Cucumber Magnolia	4,754	0.70%	Black Birch	33	0.00%
Ninebark	4,215	0.62%	Mountain Holly	32	0.00%
American Chestnut	3,558	0.52%	Hemlock	23	0.00%
Willow	3,324	0.49%	Black Raspberry	6	0.00%
Ironwood	2,900	0.42%	Skunk Current	6	0.00%
Red Elderberry	2,546	0.37%	Wild Grape	3	0.00%
Hawthorn	2,313	0.34%	Devil's Walkingstick	1	0.00%
Lowbush Blueberry	2,243	0.33%	**Herbaceous Plants**		
Staghorn Sumac	2,102	0.31%	Penstemon	280	0.04%
Alternate Leaf Dogwood	1,975	0.29%	Smooth Oxeye	150	0.02%
Mountain Maple	1,675	0.24%	Sweet Fern	100	0.01%
Basswood	1,597	0.23%	Milkweed	8	0.00%
Nannyberry	1,586	0.23%			
American Plum	1,550	0.23%	**TOTAL Trees**	**683,894**	

Tree planters traverse the rugged landscape at Sharp Knob.

SHARP KNOB: SITE HISTORY AND PROJECT

Sharp Knob, also located on Cheat Mountain in Pocahontas County, West Virginia, shares much of the local history of the Mower Tract in that it was also formerly dominated by red spruce forests before being replaced by northern hardwoods after logging and slash fires. In addition to logging, coal mining throughout Appalachia further reduced and prevented the re-establishment of red spruce communities. On Sharp Knob, approximately 700 acres were surface mined for coal. In contrast to the nearby Mower Tract, which was mined after the 1977 mining reclamation law (requiring mining companies to return the site to approximate original contour, compact to control erosion, and revegetate with grasses or plantations), Sharp Knob was mined in the 1960's and early 70's. Before 1977, once mining was completed, the mining companies revegetated the site by seeding non-native grasses and legumes and/or planting exotic tree plantations, and then had no further obligations; the sites were abandoned, leaving mine benches and highwalls. Abandoned mines often had problems such as land instability, erosion, and water issues. Sharp Knob has flat mine benches of exotic Norway spruce and red pine plantations, grasslands, and steep highwalls with large mine ponds at the base. On the most compacted areas of Sharp Knob, due to soil compaction and thick exotic grass cover, native trees and shrubs are not able to colonize and exotic plantation trees grow stunted with shallow root systems. Roughly 60

Extensive ponds formed at the base of highwalls across Sharp Knob after mining. Beavers are active in this area, and a dam can be seen at the edge of the pond.

years have passed since mining was completed at Sharp Knob, and very few native trees have successfully established on the most compacted areas.

GFW and the USFS intend to continue fundraising for additional Red Spruce Ecological Restoration projects, as well as expand to restoration projects on mined lands in other Forest Service districts, until we've reforested as much mining-degraded land in the Monongahela National Forest as possible. The process has begun for restoring mined lands on other districts of the Monongahela National Forest. Conversations between partners have been extensive, preliminary maps have been created, and a portion of the funding has been secured, and we expect to begin work in 2023 or 2024.

Red Spruce Ecological Restoration on Sharp Knob has been a collaborative effort between GFW, USFS-Monongahela National Forest, Komatsu, Appalachian Headwaters, Argosy Foundation, Snowshoe Mountain Ski Resort, Appalachian Stewardship Foundation, Mennen Environmental Foundation, National Forest Foundation, Appalachian Regional Reforestation Initiative, Office of Surface Mining Reclamation and Enforcement, The Nature Conservancy, AmeriCorps-Appalachian Forest National Heritage Area, Natural Resources Conservation Service-Appalachian Plant Materials Center, Central Appalachian Spruce Restoration Initiative (CASRI), Arbor Day Foundation, West Virginia Highlands Conservancy, University of Kentucky, and many others.

Table 3. List of native species planted at Sharp Knob each year. A total of 128,515 trees, shrubs, and herbaceous plants of 39 species have been planted from 2018 to 2022.

Trees and Shrubs	2018	2019	2020	2021	2022
Red Spruce	9,000	5,750	11,332	12,100	10,370
Yellow Birch	1,500	2,000	8,400	3,300	2,061
Black Cherry	1,000	1,000	4,200	2,200	5,600
Sugar Maple	1,000	50	2,100	2,000	2,250
Red Maple		1,000	4,200	1,850	1,980
Quaking Aspen	1,500		3,000	1,100	1,080
Allegheny Serviceberry	775	300	1,200	570	1,100
Red Osier Dogwood				545	1,625
Black Elderberry					1,100
Red Elderberry					1,100
Silky Dogwood				540	485
Diervilla lonicera				400	
Speckled Alder	1,500	513	1,200	380	1,015
Alternate-leaf Dogwood				264	306
Winterberry Holly				264	775
Choke Cherry				201	
Hornbeam				38	
Cucumber Magnolia				27	
Arrowwood Viburnum		3		20	1,150
American Chestnut [1]		500		250	
American Hazelnut	100	3			1,080
American Plum	200				
Black Chokeberry		72			
Butternut		100			
Fraser Magnolia		11			
Lowbush Blueberry		25			
Mountain Ash	800	300	1,200		823
White Oak	100				
Wild Raisin		20			12
Willow		2			
Witch Hazel		150			
Herbaceous Plants					
Tall Sunflower				325	
Gray-headed coneflower				300	
Common Milkweed				30	
Blue Vervain	200	150			
Boneset	200	150			
Joe Pye Weed	200	150			
Swamp Milkweed	200	150			
TOTAL	**18,775**	**11,899**	**37,082**	**26,454**	**34,230**

[1] Backcrosses provided by The American Chestnut Foundation

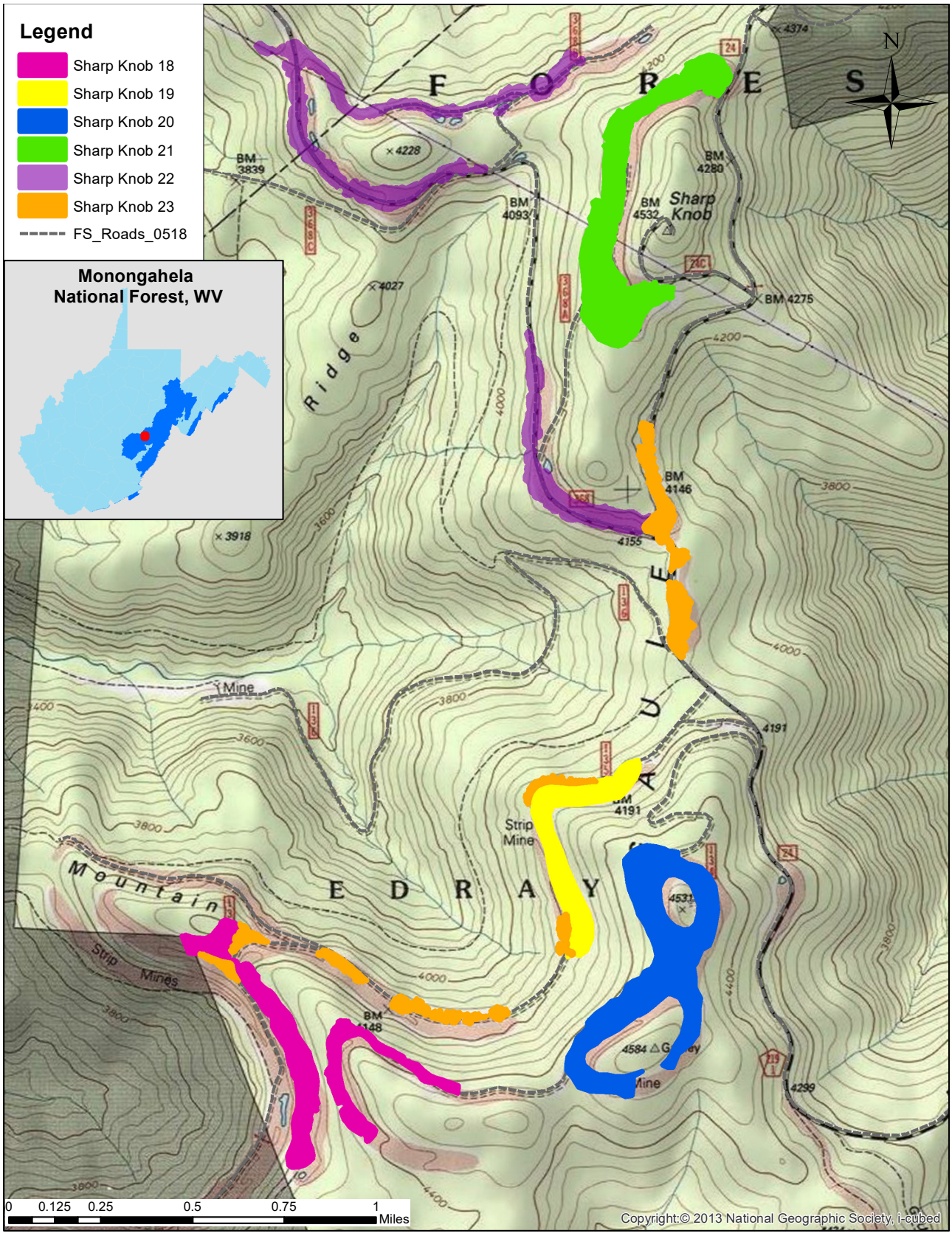


Figure 3. Map of restoration areas by year at Sharp Knob.

SHARP KNOB RESTORATION ACTIVITIES

Since Green Forests Work began working with the U.S. Forest Service-Monongahela National Forest and other partners on Sharp Knob, restoration projects have taken place annually since 2018. Prior to planting, non-native species were removed and the soil was decompacted. So far, 215 acres have been restored. This has included the creation of 93 wetlands and the planting of over 126,000 trees and shrubs (species are listed in Table 3), as well as over 2,000 native herbaceous plants (Table 4). Seeds of flowering species for pollinators have been spread throughout the restoration area. Although the majority of the planting has been accomplished by professionals, 57 volunteers have assisted us in these efforts. Another 26 acres were decompacted in fall 2022, and will be planted with 17,500 trees in spring of 2023. This will complete the mined land restoration on Sharp Knob.

Table 4. Yearly summary of restoration activities.

Year Restored	Acres Reforested	Wetlands Created	# of Trees & Shrubs Planted	# Species	Event Type	Volunteers
2018	35	8	14,800	12	Professional	
2018			3,175		Volunteer	57
2019	22	2	11,299	17	Professional	
2020	65	5	37,082	10	Professional	
2021	47		25,799	17	Professional	
2022	46	78	34,230	19	Professional	
Total	**215**	**93**	**126,385**	**32***		**57**

* In addition, over 2,000 herbaceous transplants of 7 species planted, and dozens of pollinator species seeded.

RESEARCH ACTIVITIES

NATIVE PLANTS

Decompaction of mine soil is a critical site preparation activity for restoration of native plant communities. Additionally, when fragments of native forest are adjacent to mine benches, decompaction may provide an opportunity for native plants to disperse onto the site. Casual observation of vegetation colonization after succession seemed to suggest that species diversity was increasing due to the ripping, but it was not clear if the new species were coming from the soil or being dispersed by wind and/or animals. So, a study was performed to examine this. Prior to decompaction, soil samples were taken on a 40-year-old mine bench that contained 45 species (Figure 4). The soils were cold stratified, grown in a greenhouse for 125 days for spring germination, dried, then grown for 102 days for fall germination. A total of 55 species emerged from the soil seed bank. Vegetation assessments were performed on the same mine bench in the spring following decompaction and a total of 108 species were identified. Although decompaction increased native species richness by 63 species, exotic and invasive species were present prior to ripping and persist on the site after. Future monitoring will reveal whether this phenomenon is a temporary spike in richness in the first growing season or if it persists into the future.

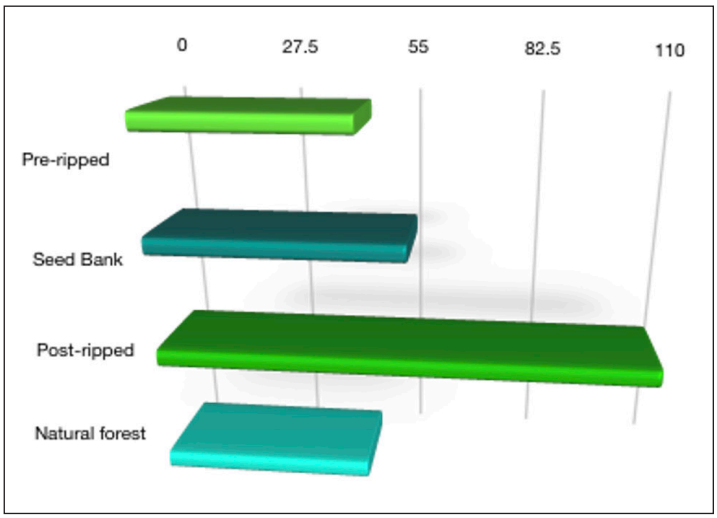


Figure 4. Number of plant species growing on mine bench before ripping, grown from the soil seed bank, growing the spring after ripping, and growing in the adjacent native forest.

Research plots were established on a newly ripped site. Seed trials were performed to learn which species can establish on mine soils from seed, and which do better when protected by woody debris.

LARGE WOODY MATERIAL AND NATIVE SEED

From very early on in the MNF ecological restoration project, we have been pushing down stunted, mostly monoculture, exotic tree plantations before decompacting the ground, and then repurposing the large woody material, spreading it back over the sites. There are innumerable ecological benefits to woody debris in forest ecosystems: slow release of nutrients and breakdown of organic material for soil building; to stabilize and reduce erosion; for habitat structure, perches, nesting and hiding places for wildlife; to provide microhabitat to planted trees, protection from hot and cold extremes, and wind and weather events; and as obstacles to herbivores, to name a few.

Another restoration technique that we've been implementing on a smaller scale nearly all along has been seeding of native, pollinator-friendly flowering species on freshly ripped restoration sites. We had only anecdotal evidence of which species could thrive best in the harsh conditions and mine soils, but in order to seed on a larger scale we wanted to know for sure. We direct seeded 9 native herbaceous and 1 shrub species on ripped ground in the Mower Tract to examine the influence of woody debris on native seed germination, seedling survival, and cover in the first growing season. The 10 species were individually sown in autumn 2018 after soil decompaction in 1 m^2 plots with and without woody debris. Germination was highest for showy ticktrefoil (*Desmodium canadense*) without wood at 66.7%; survival was highest for staghorn sumac (*Rhus typhina*) with wood at 98.1%; and final cover was highest for blackeyed Susan (*Rudbeckia hirta*) without wood at 4.4%. We had seen, anecdotally, that protection under woody debris increased the odds of survival, but this study proved that the odds of survival for all 10 species with woody debris versus without was approximately 2:1. This study was recently published in Native Plants.

University of Kentucky students examine wildlife recruitment in created wetlands and reforestation areas.

CREATED WETLANDS

In an effort to better understand the effectiveness of our wetland creation endeavors, we have undertaken several research projects to examine the utility of these modified landscapes for providing wildlife habitat and restoring ecosystem services. One study was performed to examine amphibian use of created wetlands on the Mower Tract. We sampled 39 of the created wetlands at four ages (2, 4, 6, and 8 years since construction) to: 1) characterize differences in wetland habitat, 2) estimate amphibian occupancy and abundance, and 3) identify wetland characteristics most important for amphibian utilization of wetlands. In the one-year study, we captured over 2,200 amphibians from 8 species including: green frog, wood frog, American toad, gray treefrog, spring peeper, spotted salamander, eastern newt, and four-toed salamander (Table 5). Water quality within the wetlands was good, which contrasts with several studies in the region where poor water quality in streams from mining has resulted in low occupancy and abundance of amphibians. Results indicated that, with adequate site preparation, created wetlands on the reforested surface mines provide suitable habitat for pond breeding amphibians.

Table 5. Amphibian use of created wetlands.

Amphibian Species	Age 2	Age 4	Age 6	Age 8
Green Frog	X	X	X	X
Wood Frog	X	X	X	X
Spring Peeper	X	X	X	X
Gray Tree Frog				X
American Toad	X			X
Eastern Red Spotted Newt	X	X	X	X
Spotted Salamander	X	X	X	X
Four Toed Salamder				X

Dr. Barton stands amongst red spruce saplings planted in 2011.

10-YEAR OLD SPRUCE

The Mower Tract ecological restoration project began in 2010 at the site referred to as Barton Bench. The restoration activities included terrestrial restoration (deep ripping and native species plantings on 90 acres) and wetland restoration (approximately 130 wetlands created and planted with native species) and was completed in 2011. Ten years later a chronosequence study was performed to compare red spruce height growing on mined land to spruce that was planted in old field sites (primarily former pastures). Interestingly, the spruce planted on the mine sites were statistically taller than those planted in old fields at years 7 and 10. The increased height is likely due to a combination of soil chemical and physical factors.

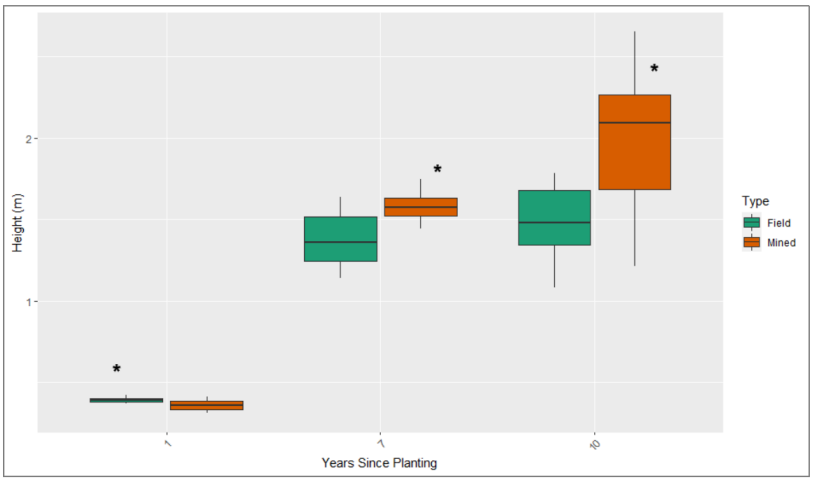


Figure 5. Comparison of seedling heights between mined and old field transects at years 1, 7, and 10. Boxes represent medians and interquartile ranges, whiskers represent non-outlier minimums and maximums, and dots represent outliers. Asterisks indicate the significantly greater site type at years when significant height differences were observed.


Appalachian Conservation Corps members perform various restoration activities on the project sites.

APPALACHIAN CONSERVATION CORPS

In 2022, with funding from the National Forest Foundation, GFW was able to contract Conservation Legacy – Appalachian Conservation Corp. (ACC) AmeriCorps crews to help with restoration and habitat enhancement projects on the Monongahela National Forest (MNF) mined lands. The objective was to provide young adults and/or veterans with training and work opportunities through the ecological restoration of degraded lands in our National Forests. Through the program, we trained and employed twenty young adults to perform habitat restoration in wetlands, coal mine impacted landscapes, non-native invasive species (NNIS) control, and restoration of wetlands and riparian areas from June to October 2022.

The 8-member ACC hand crew and 6-member saw crew received hands-on training and completed a total of 5, nine-consecutive-day periods of work, or “hitches”. The hand crew completed 3 hitches and accomplished the following on the MNF: Two hitches were spent working in Sharp Knob restoration area scanning for and removing NNIS, including autumn olive, bush honeysuckle, multiflora rose, and Japanese barberry from 11 miles of mined land restoration area roadsides; they moved 59,585 total cubic feet of brush piles to larger piles; the crew seeded 34.5 acres on the Mower 22 mine reforestation area, and 30 acres on the Sharp 22 mine reforestation area with 19 species of native flowering species for pollinators, including 1 native grass and 2 fruit-bearing shrubs; and they planted 200 willow cuttings in ~.25 acre of wetlands at Mower 22. The hand crew’s third hitch was spent removing NNIS, including Japanese stiltgrass, multiflora rose, and autumn olive from Panther Ridge Restoration Area and Blue Bend recreation area. The saw crew completed 2 hitches and performed 32 acres of NNIS removal and herbicide treatment and they felled trees for riparian restoration in a 10.8 acre triangle between the First Fork of Shavers Fork and Old House Run on Cheat Mountain.

The young adults sharpened their skills and acquired many new ones. Hard work in teams built character and enhanced their sense of leadership. GFW and USFS staff educated the crews on the reasons for the greater ecological restoration work on the mined lands and their role in it, which elevated their sense of environmental responsibility and stewardship. Crew members had positive and memorable experiences, while enhancing the impact of the ecological restoration work and fulfilling project needs.

PATH FORWARD

Work at the Mower Tract and Sharp Knob continues. Site preparation on 160 acres at Mower and 26 acres at Sharp Knob have been completed and these areas will be planted in the spring of 2023. Believe it or not, major restoration activities at both sites will be completed at that time. However, we must ensure that the restoration activities grow into successful red spruce ecosystems which will require many years of monitoring and maintenance. These maintenance activities may include invasive species control, replanting in areas experiencing damage due to wildlife browse, or activities to increase natural spruce colonization, including spruce release in areas adjacent to the restoration area.

With continued funding from the Forest Service and our partners, we will also seek out other reforestation and ecological restoration opportunities on disturbed landscapes found within the Monongahela National Forest. The partnerships formed over the last decade on this project are special and we feel that this is a model of what a successful collaboration for ecological restoration looks like. We are excited to see these projects continue.

VIDEO LINKS

ACC SUMMER CREW

https://youtu.be/Rz4xGWt-Nuc

GFW SUMMER INTERN - OTIS KATZ

https://youtu.be/oXVFIk-eUzU

MOWER TRACT: MONONGAHELA NATIONAL FOREST

https://youtu.be/NePBrnZQf08

CONTACT US

CHRIS BARTON
President
859.619.1532
barton@greenforestswork.org

ANNA MARIA BRANDUZZI
Reforestation Coordinator
412.996.0517
branduzzi@greenforestswork.org

MICHAEL FRENCH
Director of Operations
812.447.3285
michael.french@greenforestswork.org

MAY MAY BARTON
Director of Marketing & Communications
859.806.8753
maymaybarton@greenforestswork.org

PROJECT PARTNERS AND SPONSORS

Arbor Day Foundation

American Forests

AmeriCorps, Appalachian Conservation Corp - Conservation Legacy

AmeriCorps, Appalachian Forest National Heritage Area

Appalachian Headwaters

Appalachian Mountains Joint Venture

Appalachian Regional Commission

Appalachian Regional Reforestation Initiative

Appalachian Stewardship Foundation

Argosy Foundation

Brad Stanback and Shelli Lodge-Stanback

Central Appalachian Spruce Restoration Initiative

Coal Country Beeworks

Canaan Valley Institute

Chicago Botanical Society

Claude Worthington Benedum Foundation

Environmental Protection Agency - American Rivers

Komatsu

Mennen Environmental Foundation

Mountain Ridge

National Forest Foundation

Natural Resources Conservation Service - Appalachian Plant Materials Center

The American Chestnut Foundation

Treecycler

The Mountain Institute

The Nature Conservancy

Pisgah Banjo Company

Ridgewater LLC

Snowshoe Mountain Resort

University of Kentucky

U.S. Forest Service - Monongahela National Forest

U.S. Fish and Wildlife Service

Northern West Virginia Brownfields Assistance Center

West Virginia Department of Environmental Protection

West Virginia Division of Natural Resources

West Virginia Division of Forestry

West Virginia Highlands Conservancy

West Virginia University